

# Technical Notes

## Americium Contamination Incident in a New York State Health Department Laboratory

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The Department's Division of Laboratories and Research at New Scotland Avenue, Albany, N.Y., under the direction of Dr. Donald V. Dean, maintains radiological sciences laboratories in support for the Department's radiological health program, which is administered by the Bureau of Radiological Health. Since June 1967, the Division's laboratory at 55 Russell Road in Albany has provided radiochemical analysis and low-level counting of samples of air, water, milk, and food. From 1963 to 1967, that laboratory functioned in rented space at 22 Colvin Avenue, Albany, N.Y.

In February 1970, extensive alpha contamination was discovered in the Russell Road laboratory. The investigation of the source of contamination in the Russell Road Laboratory brought the investigators, inevitably, back to the former Colvin Avenue premises.

The source of this contamination was so unlikely and unsuspected that only coincidence revealed its existence. Aside from routine uranium analysis, no work with alpha emitters had ever been performed at Russell Road. From 1962 to 1965, work with plutonium-239 had been carried out at the New Scotland Avenue laboratory and a electro-deposited disc had been counted at the Colvin Avenue laboratory. Routine and regular monitoring of the division's laboratory had not revealed the contamination—primarily because the emitter was an isotope not used in regular procedures and research at the laboratory.

On February 5, 1970, a small radium calibration standard sealed in a Tri-Carb liquid

scintillation unit at the Russell Road laboratory was suspected of having ruptured. An alpha survey disclosed no contamination associated with this source, but did reveal extensive alpha contamination on chairs, desks, benches, file cabinets, and other appurtenances. This contamination was so gross that the investigators, headed by Dr. Joseph Sharp, Director of the Russell Road laboratory, decided that the contamination could not have emanated from the calibration source.

That weekend, Doctor Sharp and his team identified, isolated, packaged, and stored in a locked room at the laboratory, all contaminated materials which they found.

The pattern of the contamination found in certain books, particular areas of the laboratory, and in a sports jacket implicated one particular laboratory researcher (Mr. N), even though his assigned work in the laboratory only involved instrument repair, development, maintenance, and calibration. This researcher had been a full time employee of the laboratory since 1965 and had been a consultant since 1963.

Doctor Sharp visited Mr. N at his home on Sunday, February 8th. and discussed the problem with him. Subsequent examination of Mr. N's home with his consent, revealed contamination similar to that found in the laboratory. In the course of the investigation, Mr. N removed a small cardboard box containing a metallic object from a bureau drawer and turned the packet over to Doctor Sharp as well as the contents of the bureau drawer.

Both the box and the metallic object were found to emit alpha activity which subsequent isotopic analysis established as being primarily americium-241 with a small fraction of plutonium-239 as a casual impurity.

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COLLECTION MARKEY FILES

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Americium-241 is an artificially prepared, silvery, radioactive metal with a physical half-life of 458 years (1) and a biological half-life of about 195 years in bone (2). Maximum permissible body burden for americium-241 in bone for a radiation worker is 50 nanocuries compared to 100 nanocuries for radium-226 and 40 nanocuries for plutonium-239 (2). Americium-241 has a 60 keV gamma energy with an external gamma dose rate of 0.039 mR/h at one meter per millicurie (3). Americium-241 is a daughter of plutonium-241 and the parent of neptunium-237. The nonoccupational maximum permissible concentration (MPC) in air is  $2 \times 10^{-13}$   $\mu\text{Ci}/\text{cm}^3$  and in water,  $9 \times 10^{-5}$   $\mu\text{Ci}/\text{cm}^3$ . Inhalation represents the most likely source of exposure. The fraction of americium reaching the bone from ingestion is  $2.5 \times 10^{-5}$  and from inhalation  $6.3 \times 10^{-2}$  (2).

The metal slide in the box was contaminated with americium-241 from a primary source which Mr. N reported had been returned to the vendor. This source was located by the vendor and forwarded to the Atomic Energy Commission for analysis.

With the assistance of the U.S. Atomic Energy Commission, selected materials were sent to Idaho Operations Office for analysis:

1. metal slide from pillbox from Mr. N's residence.
2. Handbook of Chemistry and Physics from the Radiological Science Laboratory, and
3. the original source.

The metal slide was contaminated on both sides with the maximum activity on one side calculated to be about 49  $\mu\text{Ci}$  of americium-241. The handbook was contaminated with americium-241 estimated to be not more than 0.2 to 0.3  $\mu\text{Ci}$ .

The original source, consisting of a metal disc  $\frac{1}{16}$  inch thick by  $1\frac{1}{4}$  inch in diameter, was calculated to have a source strength of 10 millicuries at the time of analysis. A circular shaded area was observed in the center of the disc similar to that produced by an electrodeposition cell. It is not known whether the source was prepared by electrodeposition, direct evaporation or by other means.

Plutonium-239 is a casual impurity remaining from the original preparation of ameri-

cium-241, and neptunium-237 is the daughter product of radioactive decay of the americium-241, whose concentration relates directly to the age and concentration of americium-241. The ratios of americium-241 to plutonium-239 and plutonium-239 to neptunium-237 indicate that the contamination originated from a single source.

It might be noted here that a laboratory in New Jersey had been licensed by the Atomic Energy Commission in 1963 to possess an americium-241 plated foil source not to exceed 50 millicuries, with a total possession limit of 100 millicuries. Mr. N was an employee of the laboratory at that time and the license provided that the source be used by or under his supervision. This license expired in 1967.

Fixed and removable alpha activity of up to 100,000 cpm was found by scintillation and gas-flow alpha field survey equipment at the N home (table 1). The results of air samples taken with a Hi Vol sampler showed three times the MPC for a nonoccupational worker in the workshop and five times the MPC in the master bedroom (table 2). Mr. N agreed that he and members of his family would undergo whole body counting examinations. In addition

Table 1. Summary of selected survey results using scintillation and gas-flow alpha survey equipment in N residence, February 10, 1970

Survey	Direct reading in counts per minute <sup>a</sup>	Results of swipe analysis in counts per minute <sup>b</sup>
Master bedroom:		
Closet floor.....	300-5,000	
Dresser drawer handle.....	2,000	150
Shoes (soles).....	400	
Dresser top.....	3,000	2,500
Man's coat.....	12,000	
Suit.....	1,200	
Bathroom:		
Scale.....	70,000	100,000 } two separate 10,000 } swipes
Daughter's bedroom:		
Chair.....	Background	
Desk.....	Background	
Bed.....	Background	
Ten-year old boy's bedroom:		
Desk.....	1,400	200
Den:		
Bookcase shelf.....	600	
Family room:		
Dark brown briefcase.....	100,000	8,000
Workshop:		
Bench.....	10,000	4,000
Floor.....	2,000	2,500

<sup>a</sup> PAC-1SAG—alpha scintillation equipment.

<sup>b</sup> PAC-3G—gas flow alpha survey meter.

**Table 2. Air sampling results**

Surveyed area	Americium-241 concentration in air (dCi/m <sup>3</sup> )
Soluble—maximum permissible concentration in air:	
Nonoccupational	200
Occupational	6,000
N residence:	
Prior to decontamination:	
Workshop	630
Master bedroom	1,010
During decontamination:	
Family room	990
Ten-year old son's room	90
Following decontamination:	
Family room	< 2
Upstairs hall	< 2
Upstairs hall with air conditioning equipment on	180
Family room with air conditioning equipment on	120
Health Department Laboratory:	
55 Russell Road Chemistry Laboratory during decontamination	27.7
22 Colvin Avenue during decontamination	20

to the N family, a number of others who were friends or close working associates, who might therefore have a possible body burden, were requested to participate in bioassay studies and whole body counting examinations. The Department summoned its radiological specialists from regional offices at Buffalo and White Plains to assist in the Albany investigation. The New York University Medical Center staff assisted with the whole body counting.

The preliminary report on the results of the whole body counting examinations indicated the following body burdens:

Mr. N, age 57	87 nanocuries
Son, age 10	93 nanocuries
Wife, age unknown	13 nanocuries
Son, age 20	11 nanocuries
Daughter, age 18	6.5 nanocuries

Recounts at New York University reported a body burden of 89 nanocuries for Mr. N and 40 nanocuries for the 10-year-old son, with a significant fraction of the americium-241 contained in the skeleton. Argonne National Laboratory reported body burdens of 65 nCi for Mr. N and 42 nCi for the 10-year-old son. The whole body counting results for all other persons involved were negative.

Twenty-four hour urine samples were collected from the N family and laboratory workers. One laboratory reported all urine results as negative, another laboratory showed ele-

vated levels for Mr. N and his 10-year-old son of 4.92 and 2.93 dpm/sample respectively, and four laboratory personnel showed moderately elevated levels of approximately 1 dpm/sample.

The human exposure of Mr. N and his son was evidently chronic, occurring since 1963, 1964 or 1965. Findings to date indicated extensive contamination in Mr. N's private residence, the Russell Road low level counting laboratory, and measurable body burdens of americium-241 in Mr. N's family.

A parallel investigation conducted by the Bureau of Radiological Health revealed alpha contamination at the former department laboratory site on Colvin Avenue. The contamination was fixed to such an extent that decontamination efforts are still being conducted at that location (tables 3 and 4).

**Table 3. Selected survey results using scintillation and gas-flow alpha survey equipment at 22 Colvin Avenue on February 11, 1970**

Location	Direct reading in counts per minute <sup>a</sup>	Direct reading in counts per minute <sup>b</sup>	Results of swipe analysis in counts per minute <sup>b</sup>
Floor tile	700	750	Negative
Floor tile	400	500	
Floor tile	200	250	
Floor tile under drinking fountain	700		
Light switch	200		
Electric box	8,000	10,000	
Outside door	400	700	

<sup>a</sup> PAC-1 SAG  
<sup>b</sup> PAC-3 G

**Table 4. Selected survey results using FIDLER instrument at 22 Colvin Avenue on February 23, 1970**

Location	Gross reading* (cpm)
A	2,000
B	500
C	500
D	12,000
E	1,500
F	10,000
G	30,000
H	40,000
I	2,500

\* Readings at 1 inch from floor using HV-1 scale. Background-250 cpm, FIDLER field calibration with 30 Am source, HV-1 scale reading at contact 8.6 cpm approximately equivalent to 100 dpm/100 cm<sup>2</sup>.

Health Department officials conferred with representatives of the Atomic Energy Commission and the U.S. Public Health Service to review the findings in the investigation and to arrange for additional assistance. The Depart-

ment, on February 17th, requested the Atomic Energy Commission to provide assistance by a radiation contamination (RADCON) team. A four-man team from Ballistic Research Laboratories, Aberdeen Proving Ground, Md., arrived in Albany that night.

The team met with Health Department investigators for briefing sessions the next morning. The team's instrumentation included a field instrument for the detection of low energy radiation, known as a "FIDLER". This "FIDLER" proved extremely useful measuring the 60 keV gamma energy of americium-241. It consists of a thin ( $1\frac{1}{16}$  inch) 5-inch diameter NaI Harshaw crystal with an Eberline pulse rate meter. It was able to detect the 60 keV gamma radiation of americium-241 in rugs, mattresses, and tile that had not been detectable by conventional scintillation or gas-flow alpha survey instruments.

With the additional support provided by the RADCON team, investigative priorities were established including a resurvey of the N home, the school attended by N's younger son, a recreation center attended by the family, and parts of the Russell Road laboratory and former laboratory site on Colvin Avenue.

This resurvey verified the preliminary findings of the Health Department staff and located fixed activity not previously identified in rugs and under tiles.

The RADCON team proved of considerable assistance in defining the extent of the problem. The Public Health Service obtained three additional "FIDLERs" from the National Aeronautics and Space Administration for use in the survey. All suspected locations and areas where contamination might be thought to have occurred were monitored. In each such instance, the Department notified the property holder whether the findings were negative or positive. If positive, the notification included recommendations for corrective action.

Dr. Hollis S. Ingraham, the New York State Health Commissioner, issued an order on February 19th, prohibiting access or entry to the N family home to any person, except with the specific authorization of the Commissioner of Health. This included Mr. N and members of his family who took up temporary residence in

a motel.

The Commissioner's action was designed to prevent a spread of contamination, and provide additional impetus for identifying and cleaning up contaminated areas in and on the N premises.

Another order by Commissioner Ingraham required that Mr. N submit to him an acceptable and detailed plan for:

- A. the reduction of levels of alpha contamination in the house so as not to exceed the following limits in the interest of health and safety:  
fixed contamination: average 500 dpm/100 cm<sup>2</sup>; maximum 2,500 dpm/100 cm<sup>2</sup>;  
removable contamination: 100 dpm/100 cm<sup>2</sup>;
- B. the protection of personnel carrying out decontamination procedures;
- C. the techniques to be employed in measuring levels of radioactivity;
- D. the types of packaging and disposal to be used for contaminated removable, disposable items;
- E. the prevention of offsite contamination, and
- F. the identification of individuals and corporations proposed to be engaged pursuant to the plan, including training, experience and licenses held.

Close associates of the N family, who ate and slept in the home with any frequency, were investigated if there was a strong likelihood that they might have inhaled or ingested radioactive dust.

Two maids had lived in the N household during the period since 1963. One, who had lived in the N home while the family was in New Jersey, was easily located in that State. The other maid, who had lived in the New Jersey home and the Albany residence occupied by the N family, had since returned to her native Germany. Whole body counting of the New Jersey maid showed a low (7 nCi) but measurable body burden, and the German authorities reported that the maid living in Germany was found to have a negative whole-body count.

A cat in the N household became sick and died during the investigation. The preliminary report on the body burden of the cat shows

approximately 2.5 nCi. Additional studies are planned.

Mr. N contracted with Applied Health Physics of Pittsburgh, Pa., to decontaminate his residence. This was done under a license issued on April 10, 1970, by the Bureau of Radiological Health. Bureau staff closely observed the decontamination. After a final survey, the Commissioner's order prohibiting access to the home was lifted in May 1970.

All premises or likely locations where contamination occurred were resurveyed with the FIDLER. Fixed activity in the floor at 22 Colvin Avenue was verified. Hi Vol air sample results for americium-241 were below permissible limits. The premises are presently being decontaminated. Contamination was also found in two other private residences in Albany, N.Y. The moving van that had transferred Mr. N's belongings from New Jersey to Albany, N.Y. sometime in 1965 was found and surveyed. Contaminated materials in the private residences have been removed and packaged for ground burial (table 5).

Nine private residences, a recreational center, a public school, a college dorm room and an apartment were carefully surveyed with the FIDLER and no contamination found.

It was concluded by department investigators that the contamination in the Colvin Avenue laboratory and in the furniture and equipment moved from Colvin Avenue to the Russell Road laboratory was transported by Mr. N to the laboratory on his person, his clothing and other of his personal belongings and books.

The investigation may be summarized briefly even though it is continuing.

The Department has engaged Dr. Neil Wald of Pittsburgh, an internationally recognized expert on americium radiation as a consultant to assist with the continuing medical investigation indicated as a result of the whole body counting.

Mr. N's home has been decontaminated and the family lives there. Mr. N has left the health department.

All identified sources of americium contamination revealed by this investigation have been decontaminated, with the exception of some fixed activity in the floor of a truck and the former laboratory site at Colvin Avenue. The fixed activity located is yielding, but stubbornly, to continuing decontamination efforts.

#### REFERENCES

- (1) PUBLIC HEALTH SERVICE, BUREAU OF RADIOLOGICAL HEALTH. Radiological Health Handbook, Revised Edition 1970. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (1970).
- (2) INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. Report of ICRP Committee II on permissible dose for internal radiation (1959). Health Phys 3:1-380 (1960).
- (3) WANG, YEN, Editor. Handbook of Radioactive Nuclides (1969). The Chemical Rubber Company, Publisher, Cleveland, Ohio.

Table 5. Locations, equipment and premises surveyed for americium contamination and action initiated

Contamination identified	Location	Action
Health Department for low level counting laboratory	55 Russell Road, Albany, N.Y.	All contaminated equipment, supplies, and materials packaged and shipped for burial.
N residence	Albany, N.Y.	Premises decontaminated in accordance with order of Commissioner of Health.
Laboratory space leased by Health Department 1963-1967. Temporary residence of N	22 Colvin Avenue, Albany, N.Y. Albany, N.Y.	Premises decontaminated. Contaminated carpet and tiles removed and packaged for ground burial.
Household items transferred from N temporary residence to another location	Albany, N.Y.	Contaminated rugs, mattress, lampshades and cushions packaged for ground burial.
Truck transferring household belongings of N in 1965 from New Jersey to Albany, N.Y.		Truck decontaminated except for fixed radioactive contamination in "one spot" on floor of trailer.